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(71) Applicant: Wagner, John William
8001 Lakemont Drive Northeast
Seattle Washington 98115(US)

(72) Inventor: Wagner, John William
8001 Lakemont Drive Northeast
Seattle Washington 98115(US)

(74) Representative: Everitt, Christopher James
Wilders et al,
F.J. CLEVELAND & COMPANY 40/43 Chancery Lane
London WC2A 1JQ(GB)

(54) Method and blank for making custom dental impression trays.

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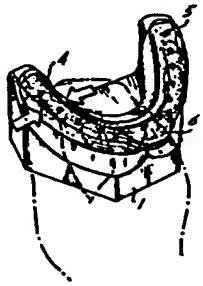
Fig. 3.



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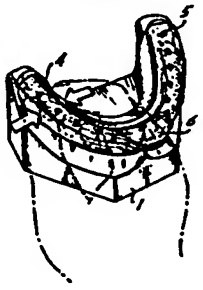

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model.

Since some of the tissues of which an impression is required are quite soft, the impression material used must be even softer to prevent distortion of the tissues as the impression material is pressed into contact with such tissues. The softness of the tissues also makes it extremely important that the impression tray correspond closely to the size and shape of the area to receive the prosethesis. As noted by C. W. Ellinger at page 110 of his book Synopsis of Complete Dentures (published by Lea & Febiger, U.S.A., 1975), "An impression tray is the most important part of an impression, regardless of technique". If at any location the overall width of the tray is too great, or the width of the tray channel is too narrow, the gum tissues are stretched or compressed by the tray, leading to an inaccurate impression. As stated at page 111 of Synopsis of Complete Dentures,

> "Since all edentulous ridges vary, it would seem that the ideal tray is one that is specifically made for the patient. The borders of this tray can be adjusted so that they control the movable soft tissues around the impression with little distortion to these tissues. At the same time, space may be provided inside the tray consistent with the characteristics of the impression material being utilized."

The word "custom" is used herein to describe such an impression tray made specifically for an individual patient.

Synopsis of Complete Dentures, particularly in Chapter 10, also discusses several alternative methods for forming a custom dental impression tray. In each instance a preliminary impression is taken by use of a "stock" tray which may be available in three or four standard sizes. If plastic modeling compound

is used as the preliminary impression material, the hardened compound can be removed from the tray, trimmed to the desired thickness and height, and the concave impression "relieved" by scraping or cutting away the hardened compound at desired locations leaving room for the final impression material. In this method the preliminary impression itself is used as the custom tray, and the custom tray is used to obtain a final impression which serves as the mold for the "master" model on which the dental prosthesis is formed.

A problem with this method is that the trimmed, hardened modeling compound is somewhat brittle. It is difficult to apply the localized pressure required to obtain a good final impression without breaking the trimmed hardened tray. As a result, a more popular method for making a custom impression tray is to use the initial impression as a mold for a "study" model on which a custom tray of acrylic resin can be formed.

Unfortunately formation of the acrylic resin custom tray is cumbersome and time consuming. The method recommended in Synopsis of Complete Dentures at pages 130 to 131 includes:

taking a preliminary impression as discussed above;

casting the study model using the preliminary impression as the mold;

using the study model to form a "record base" or "baseplate" of shellac of a desired thickness which, in effect, duplicates the prelimary impression in a harder, thinner material, and removing the baseplate from the study model;

padding desired locations of the study model by use of wax;

inverting the baseplate into a soft patty of dental stone and, after the dental stone has hardened, removing the baseplate from the hardened stone, thereby forming an approximate mold or "former" for the custom impression tray;

coating the dental stone tray mold with a separating agent, such as petroleum jelly;

mixing acrylic resin according to the manufacturer's instructions, allowing the initially substantially liquid resin to set to the "doughy" stage and distributing the doughy acrylic resin evenly in the mold; and

removing the acrylic resin from the mold while it is still pliable, placing it over the built-up study model, manually adapting it to the study model and allowing the acrylic resin to harden to form the custom tray.

By padding up the study model, the resulting custom dental impression tray has room for the final impression material.

Regardless of the method used for manufacturing the custom dental impression tray, such tray is used to obtain a final impression which serves as the mold for making the highly accurate master model on which the dental prosthesis is formed.

The invention as claimed provides a simple, quick, inexpensive method of making a dental impression tray closely appoximating the shape and size of a specific patient's jaw ridge and usable to obtain a precise impression of such ridge, including associated soft tissue, for use as a mold in manufacture of an accurate model on which a dental prosthesis can be formed.

This is accomplished by taking a preliminary impression and using it in casting a study model of the jaw ridge, then padding the study model with spacing material in desired locations, heating a sheet or flat blank of nonbrittle post formable thermoplastic material substantially rigid at room temperature but bendable and deformable when heated, manually shaping the heated blank by deforming it so as to conform to the shape of the built-up study model and allowing the

shaped blank to cool to substantially rigid condition.

The advantages offered by the invention are mainly that the method of the present invention is much less time consuming, expensive and messy then the cumbersome conventional practice of forming an acrylic resin custom dental impression tray, yet results in a sturdy thin tray corresponding closely to the shape and size of a patient's jaw ridge in the area to receive a dental prosthesis.

Ways of carrying out the invention are described in detail below with reference to drawings which illustrate specific embodiments, in which:

Figure 1 is a top perspective of a precut thermoplastic sheet usable in accordance with the present invention in the manufacture of a custom dental impression tray;

Figure 2 is a top perspective of a mandibular cast or study model including a chipped first molar;

Figure 3 is a somewhat diagrammatic top perspective of the thermoplastic sheet shown in Figure 1 and the study model shown in Figure 2 illustrating molding of such sheet to the study model to form the custom dental impression tray; Figure 4 is a somewhat diagrammatic section taken along line 4--4 of Figure 3; Figure 5 is a top perspective of the resulting custom dental impression tray removed from the study model; and

Figures 6 and 7 are corresponding top perspectives of alternative precut thermoplastic sheets usable in accordance with the present invention in manufacture of a custom dental impression tray.

The preliminary steps of manufacturing a custom dental impression tray in accordance with the method of the present invention are filling a stock dental impression tray, which may be steel, with suitable impression material, such as alginate, and obtaining a preliminary impression of the area of a patient's jaw ridge to receive a dental prosthesis.

The preliminary impression is used as a mold for a study model of, for example, plaster, which is an approximate replica of the jaw ridge. The study model is used in forming a custom dental impression tray as described below. A highly precise final impression is taken by use of the custom tray using, for example, rubber base as the final impression material, and the final impression is used as a mold for a correspondingly precise master model of, for example, die stone. The dental prosthesis, be it a partial or complete denture, a bridge, or a cap or a crown, or a wax replica of the prosthesis, then can be formed on the master model as is conventional.

The study model 1 of the mandibular ridge of a patient having a chipped first molar 2 requiring a crown is shown in Figure 2. In accordance with the present invention, the ridge of the study model is padded on both sides with a layer 3 of spacing material such as wax or tissue paper of a thickness of about 1 mm to 3 mm laterally of both sides of the ridge, as best seen in Figure 4. A substantially rigid thermoplastic sheet or flat blank 4, which may have through perforations 5, is cut into a U-shape, as shown in Figure 1, with the centerline of the U corresponding approximately to the centerline of the mandibular ridge represented by the study model. The sheet is heated beyond its softening temperature and, as indicated in Figure 3, is shaped to a tray form by being deformed over the built-up study model and manually depressed downward over the study model. Preferably a handle 6 is squeezed outward from about the center of the sheet. Upon cooling, the deformed sheet returns to its substantially rigid condition, but in the tray form indicated in Figure 5.

The resulting substantially rigid custom dental impression tray then is ready for use in obtaining a final impression from the patient. The perforations

5 through the completed custom dental impression tray may be desirable for allowing escape of excess final impression material and for good adhesion of the final impression material to the custom tray. Previously, drilling holes through a completed acrylic resin custom tray was required.

The thermoplastic sheet material must be substantially rigid at room and body temperatures so as to form a sturdy custom dental impression tray of definite shape. The softening temperature should be low enough, however, preferably no greater than about 145° F (63° C) to about 160° F (71° C), that the sheet can be handled manually in deformable condition. In heated condition, the sheet should be nonresilient and nonliquid so as to maintain its shape as it is deformed around the study model and so as to retain the through perforations; yet when heated it should be sufficiently deformable that the handle 6 can be formed at the front. In addition, the thickness of the sheet should be small enough, preferably no greater than about 3/16 inch (4.8 mm), so as to prevent deformation of soft tissue as the final impression is taken, yet large enough, preferably at least about 1/16 inch (1.6 mm), so as to be easily handled and sufficiently strong to withstand the pressure of taking the final impression.

The thermoplastic material manufactured by Rolyan Manufacturing Co. Inc. of Menomonee Falls, Wisconsin, under its trademark "Polyform" in a thickness of about 1/8 inch (3.2 mm) meets all of the above requirements and is the preferred material to be used in practice of the present invention. Such material is of the type described in Phillips et al. U.S. patent No. 3,692,023, issued September 19, 1972, in the paragraph beginning at column 4, line 30, as being a cyclic ester polymer, preferably poly-epsilon-caprolactone. It is substantially rigid at body temperatures but is deformable, nonresilient and nonliquid when heated to a temperature between about 145° F (63° C) and about 160°

F (71° C). It retains its shape sufficiently when heated that the perforations 5 drilled or punched through it prior to heating are not filled in during deformation of the heated sheet. The exterior surfaces of the heated sheet cool quite rapidly so that the sheet can be handled manually while still deformable.

Additional advantages of the Rolyan Manufacturing Co. Inc. Polyform thermoplastic material are that it is nonbrittle, both before and after cooling, and it may be cut easily with a sharp knife or scissors for trimming the substantially planar sheet before it is heated or the resulting custom dental impression tray after it is cooled. The Polyform material also may be reheated to soften it and recooled to harden it if, for example, upon examination it is found that the first effort at forming a precise custom dental impression tray with room for the final impression material has failed. The low softening temperature of the preferred material lends it to convenient heating and softening by immersion in hot water. It may be cooled rapidly by dipping it in cold water or by running cold water over it.

Preparation of a patient's tooth or teeth for crowns or bridges, for example, such as by drilling or grinding, can be completed after taking of the initial impression, whereupon the custom tray is used in obtaining a final impression which is used as the mold for the master model on which the prosthesis or a wax replica of the same is formed. Possibly the study model can be made and the custom tray formed while drilling or grinding is carried out, so that only a single sitting is required to obtain both impressions.

Substantially the same procedure is followed in the case of partial or complete mandibular dentures in which the U-shaped thermoplastic sheet is deformed over the study model of the edentulous mandibular ridge. In the case of maxillary dentures, however, a precise impression of the palate also is required. In

that instance as indicated in Figure 6, the shape of the precut thermoplastic sheet 4' will be semielliptical and the sheet will be of a width substantially greater than the edentulous maxillary ridge. The study model will include an approximate replica of the palate which also is padded with a thin layer of wax or tissue paper. The thermoplastic sheet is heated and deformed over the edentulous maxillary ridge with the central portion of the sheet being pressed downward in contact with the built-up replica of the palate.

The thermoplastic sheet 4" shown in Figure 7 is generally in the shape of a trapezoid rather than being semielliptical. As compared to the tooth arch for which the sheet 4" was designed, indicated by the broken line 7 in Figure 7, the periphery of the sheet approximates the shape of the tooth arch except in the areas of the points 8 at corresponding locations at opposite sides of the sheet where the periphery of the sheet diverges outward such that the portion of the sheet outward of the line 7 is wider in the areas of the points 8 than in other areas. Such points correspond to the locations of the protruding maxillary canines, should the same be remaining in the patient, so that there will be sufficient material to mold over the study model in the areas of the canines.

In other respects the sheets of Figures 6 and 7 are identical to the sheet of Figure 1.

Although not preferred, it is envisioned that a custom dental impression tray could be made by shaping a softened thermoplastic sheet directly over the jaw ridge in a patient's mouth, provided the temperature of the softened thermoplastic material is not so high as to damage the intraoral tissues. In this case the sheet would not be firmly pressed against the ridge but rather would be loosely shaped to correspond closely to the shape and size of the ridge but leaving a space of 1 to 3 mm between the inner surface of the shaped sheet and the teeth or tissue of the ridge, to allow room for

the final impression material in the completed custom tray.

Performed as described above, the method of the present invention is much less time consuming, expensive and messy then the cumbersome conventional practice of forming an acrylic resin custom dental impression tray, yet results in a sturdy thin tray corresponding closely to the shape and size of a patient's jaw ridge in the area to receive a dental prosthesis.

CLAIMS:

1. The method of making a custom dental impression tray used for taking a precise final impression of at least a portion of a jaw ridge of a patient which portion is to receive a dental prosthesis, which method comprises padding a study model of the jaw ridge portion with spacing material of a thickness approximately equal to the desired thickness of final impression material to be used in taking the final impression, heating a substantially rigid flat blank of nonbrittle thermoplastic material to deformable nonliquid condition, manually shaping the heated blank by deforming it over the built-up study model so as to form a cavity closely approximating the shape of the study model of the jaw ridge portion but spaced from the model a distance approximately equal to the desired thickness of final impression material to be used, and cooling the shaped blank until it returns to substantially rigid nonbrittle condition to form the custom dental impression tray.

2. The method defined in claim 1, including heating a rigid flat blank of substantially uniform thickness between about 1/16 inch (1.6 mm) and 3/16 inch (4.8 mm) to deformable nonliquid condition, and, after shaping the heated deformable uniform thickness blank, cooling the shaped blank until it returns to substantially rigid condition of substantially uniform thickness to form the custom dental impression tray.

3. The method defined in claim 1, including heating a rigid flat blank precut so as to have a generally arcuate outer periphery and of a width great enough to overhang the opposite lateral margins of the jaw ridge portion.

4. The method defined in claim 1, including heating the rigid flat blank to a temperature substan-

tially above body temperature but below about 160° F. (71° C.) to deformable nonliquid condition.

5. For use in the method of claim 1, a tray-forming blank comprising a flat, nonbrittle, substantially rigid sheet of thermoplastic material deformable upon heating to a temperature substantially above body temperature but below about 160° F. (71° C.).

6. The blank defined in claim 5, in which the thermoplastic material is nonresilient and nonliquid when heated to deformable condition.

7. The blank defined in claim 5, in which the sheet is of a thickness between about 1/16 inch (1.6 mm) and 3/16 inch (4.8 mm).

8. The blank defined in claim 5, in which the sheet has a plurality of spaced through apertures and, after heating, is deformable into channel shape without substantially plugging the apertures.

9. The blank defined in claim 5, in which the periphery of the sheet diverges outward in the areas generally corresponding to the locations of the canines of the jaw ridge.

Fig.1.

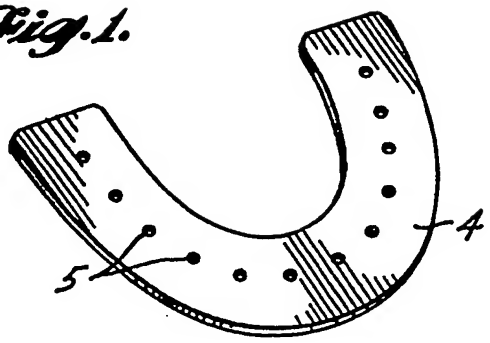
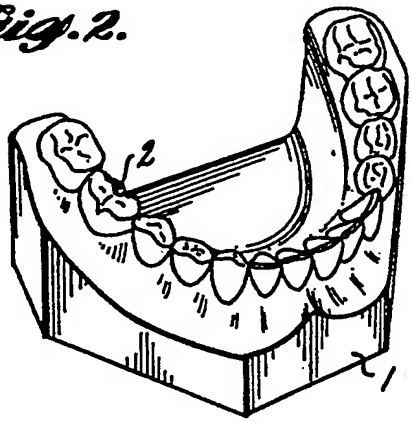


Fig.2.



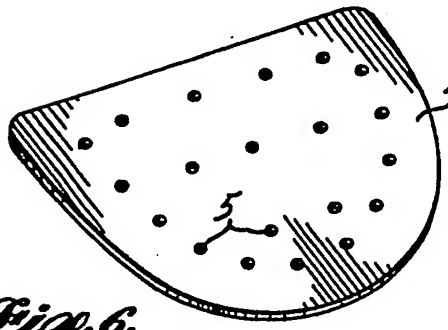


Fig.6.

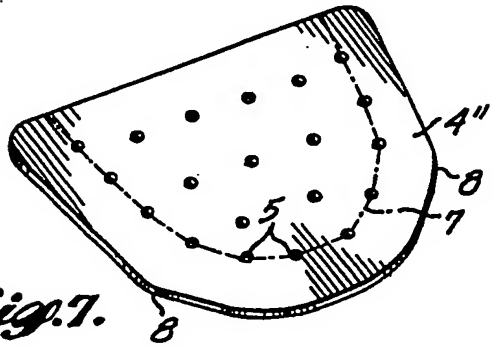


Fig.7.

Fig.3.

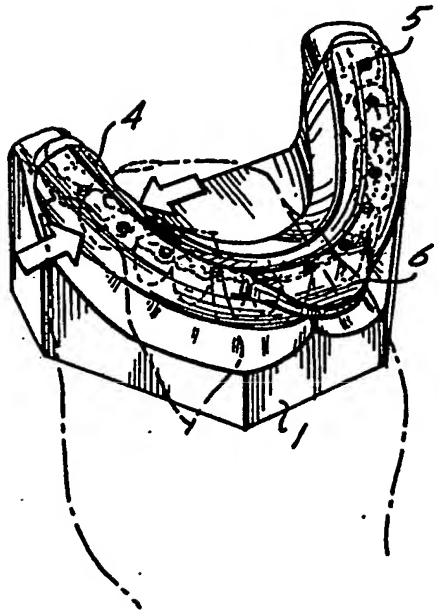
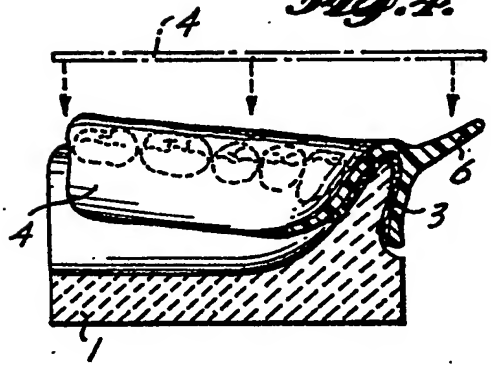


Fig.4.



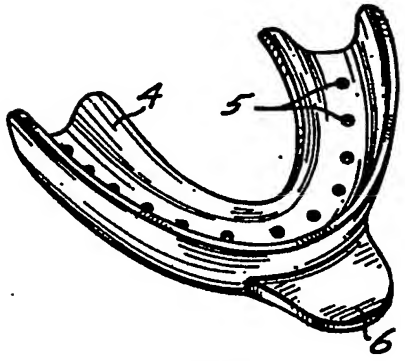


Fig.5.

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EUROPEAN SEARCH REPORT

0074182
Application number

EP 82 30 4189.2

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
Y	DE - U - 1 681 690 (BREMER GOLDSCHLÄGEREI W. HERBST) * page 1, line 19 to page 3, line 34; fig. 1 to 4 *	1,5	A 61 C 9/00
Y	DE - C - 687 180 (GERLACH) * claim 2 *	1	
Y	DE - A1 - 2 754 278 (TUREAUD)	1	
A	* page 4, line 8 to page 9, line 18 *	4-6,9	TECHNICAL FIELDS SEARCHED (Int.Cl. ³)
Y	US - A - 1 763 553 (DENNIS) * page 1, lines 51 to 81; fig. 3, 7 *	1,5	A 61 C 9/00 A 61 C 13/00
Y	DE - A1 - 2 512 443 (BISICO LUDWIGS & MARTEN OHG) * page 3, lines 8 to 20 *	1	
A	US - A - 3 473 225 (DEUSCHLE et al.) * column 2, lines 10 to 22 *	8	
A	DE - A - 1 566 208 (DREVE)		CATEGORY OF CITED DOCUMENTS
D,A	US - A - 3 692 023 (PHILLIPS et al.)		X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons
A	DE - C - 331 935 (TRYFUS)		
X	The present search report has been drawn up for all claims		&: member of the same patent family, corresponding document

Place of search	Date of completion of the search	Examiner
Berlin	11-11-1982	SIMON

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